

BIG IDEAS:

- Structure and Behavior of Microorganisms

STAGE ONE: DESIRED RESULTS

ESTABLISHED GOALS

National Science Content Standard: Unifying Concepts and Processes

Conceptual and procedural themes unify science disciplines and provide students with powerful ideas to help them understand the natural world. (Form & Function)

National Science Content Standard: Life Science – Form & Function

As a result of their Pre-K – 12 schooling, all students should develop an understanding of: the cell, the molecular basis of heredity, biological evolution, the interdependence of organisms, matter, energy, and organization in living systems, and the behavior of organisms.

Illinois Learning Standard 12.A: Know and apply concepts that explain how living things function, adapt and change.

National Science Content Standard: Science and Technology

As a result of their Pre-K-12 schooling, all students should develop abilities of technological design and understandings about science and technology.

Illinois Learning Standard 11.B: Know and apply the concepts, principles and processes of technological design.

Illinois Learning Standard 13.A: Know and apply the accepted practices of science.

Illinois Learning Standard 13.B: Know and apply concepts that describe the interaction between science, technology and society.

ESSENTIAL QUESTIONS

- What are microorganisms?
- How can I distinguish between the different types of microorganisms?
- What are microbiological techniques to observe and manipulate microbes?

ENDURING UNDERSTANDINGS

- The form of a microorganism is directly related to its use and function.
- There is and has been a great diversity of living organisms that are well adapted for the habitat in which they live.
- Cells of microorganisms carry out many specialized functions needed to sustain life, and are able to grow and divide.
- Many of the very small structures of living things are made visible to us through microscopes.
- Technological design is driven by the need to meet human needs and solve human problems. Technological solutions may create new problems, and may also challenge people's beliefs and practical explanations concerning various aspects of the world.

CORE KNOWLEDGE

- There are differences in structures between archae, bacteria, and eukarya.
- Archae and bacteria are prokaryotic cells that can be gram-negative or gram-positive.
- Protists and fungi are eukaryotic organisms that play a vital role in the environment.
- Protists are the most diverse of all eukaryotes.
- The classification of protists is likely to change in the future as we learn more about how these organisms are related to each other and to members of other kingdoms.
- Fungi have thread-like bodies, their cell walls are made of chitin, and they absorb nutrients from the environment.
- Fungi consist of diverse forms.
- Most fungi have life cycles that include the formation of asexual and sexual spores.
- Most fungi are free-living and do not require a host to reproduce.
- Viruses are not considered living because they do not grow, metabolize, or maintain homeostasis and they cannot reproduce without a host cell.
- All viruses have nucleic acid and a capsid.
- Viruses reproduce by lytic and/or lysogenic life cycle.
- Viroids and prions are nonliving pathogenic particles that are able to reproduce in host cell.

ESSENTIAL VOCABULARY

Microbiology
Microorganisms
Prokaryote
Eukaryote
Germ Theory
Koch's Postulates
Biosafety Level (BSL)
Archae
Extremophile
Bacteria
Endospore
Peptidoglycan
Lipopolysaccharide(LPS)
Gram positive bacteria
Gram negative bacteria
Capsule
Cell wall
Cell Membrane
Flagella

SCIENCE PROCESS SKILLS

- Demonstrate proper use of light microscope.
- Demonstrate proper aseptic techniques.
- Observe and identify structures in various microbes.
- Classify microbes based on structure.
- Compare and contrast differences in structures between archae, bacteria, and eukarya.
- Observe bacterial cells to differentiate between gram-negative and gram-positive bacteria.
- Utilize staining procedures to identify microbes.
- Create scientific illustrations with proper labeling.
- Predict outcomes of specified case studies.

HABITS OF MIND

- **Computation and Estimation**
Science literacy includes being able to use computational tools thoughtfully and with confidence. The teaching of science should include problem solving that emerges from student activities and the content being studied. It requires students to make calculations and check their answers against their estimates and their knowledge of the problem.
- **Manipulation and Observation**
Education for science literacy implies that students develop the habit of using tools to solve practical problems and to increase their understanding of how the world works. Tools, from hammers and notebooks to cameras and computers, extend human capabilities.
- **Critical Response Skills**
In various forms, the mass media, teachers, and peers inundate students with assertions, arguments, and claims about all kinds of things. Science education should prepare people to read or listen to such assertions critically, deciding what evidence to pay attention to and what to dismiss. Furthermore, people should be able to apply those same critical skills to their own observations, arguments, and conclusions, thereby becoming less bound by their own prejudices and rationalizations. These critical response skills can be learned, and with practice, can become a lifelong habit of mind. Critical response skills include, but may not be limited to: questioning the reliability of data;

Cilia
Pilus
Conjugation
Plasmid
Ribosomes
Cytoplasm
Fimbriae
Protists
Contractile Vacuole
Pseudopod
Parasite
Chloroplasts
Eyespots
Fungus
Chitin
Plasmodium
Sexual and Asexual Spores
Cyst
Hyphae
Vegetative structures
Thallus
Septa
Mycelia
Budding
Rhizoid
Stolom
Virus
Envelope
Nonenvelope
Capsid
Prophage
RNA
DNA
Lytic cycle
Lysogenic cycle
Prion
Nucleus
Binary fission
Pathogen
Aerobic
Anaerobic
Heterotroph
Autotroph
Vectors
Aseptic
Antiseptic
Sterile
Culture
Agar
Autoclave
Incubator

questioning sources of information for validity and bias; making sure scientific methods are reliable, consistent and reproducible; recognizing multiple points of view; and recognizing that scientific understanding is a matter of interpretation.

APPLICATIONS OF LEARNING

- **Using Technology** - Use appropriate instruments, electronic equipment, computers and networks to access information, process ideas and communicate results.
- **Working on Teams** - Learn and contribute productively as individuals and as members of groups.
- **Making Connections** - Recognize and apply connections of important information and ideas within and among learning areas.

<p>Incubation Inoculation Gram stain Light Microscopy Electron Microscopy Fluorescent Microscopy</p> <p><u>MISCONCEPTIONS</u></p> <ul style="list-style-type: none"> • Viruses are living organisms. • Antibiotics treat viral infections. • The only fungus is a mushroom. • Fungi are plants and photosynthesize. 	
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STAGE TWO: DETERMINE ACCEPTABLE EVIDENCE

FORMATIVE ASSESSMENTS	
Laboratories and Activities	Journal/Reflections
<p><u>Lab/activities:</u> Pasteur’s experiment for disproving the theory of spontaneous generation Basic aseptic technique lab Pouring agar plates Growth media and streak plates Dilution plating Bacterial growth curves Gram staining of bacteria Cell counts Microbe identification using microscopes Bacterial Fluorescence Bug Scope for Fluorescent microscopy/SEM Fungus stations and identification Fungal life cycle observations</p>	<p>Daily journal readings and reflections Current events</p> <ul style="list-style-type: none"> • What is the difference between a light microscope and more advanced microscopes (TEM, SEM, fluorescent)? • Explain the primary characteristics of a microorganism. • How does the process of Gram staining work? • Why is a virus considered a nonliving particle? • Compare and contrast prokaryotic and eukaryotic microbes. • Describe the different methods of culturing microbes.

<p>Case studies</p> <p>FM CS #3: Tools of the Laboratory: The Methods of Studying Microorganisms</p> <ul style="list-style-type: none"> • The handling of biological samples to be used for diagnostic testing. • The importance of Gram stain in microbial identification. • The use and limits of light microscopy. • The growth and isolation of pure bacterial cultures. • The importance of media type in the isolation and identification of microorganisms. <p>FM CS #4: An Introduction to the Prokaryotic Cells, Its Organization, and Members</p> <ul style="list-style-type: none"> • Prokaryotic Cell Structure • Capsule Structure <p>A Case Study Approach CS #9 Simple Staining</p> <ul style="list-style-type: none"> • Identifying the differences between prokaryotic structures. • Staining Techniques <p>FM CS #5: Eukaryotic Cells and Microbiology</p> <ul style="list-style-type: none"> • Eukaryotic • Protozoan Life Cycle • Cysts <p>FM CS #6: An Introduction to Viruses</p> <ul style="list-style-type: none"> • Identification of viruses • Isolation of viruses <p>FM CS # 10: Genetic Engineering: A Revolution in Molecular Biology</p> <ul style="list-style-type: none"> • The diagnostic role that genetic techniques may play in clinical cases. • The limits of our current genetic techniques. • The relative fragility of genetic information outside of living organisms. 	
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SUMMATIVE ASSESSMENTS	
Performance Tasks	Other Evidence
Lab practical Case study	<ul style="list-style-type: none"> • District common assessment

STAGE THREE: LEARNING PLAN

1. Basic Cellular Structure: Prokaryote vs. Eukaryote

Describe differences in structures between archae, bacteria, and eukarya.
Explain the relationship between structures of the cells and their functions.

2. Archae Form and Function

Explain how archae have genetic differences that distinguish them from bacteria.
Explain how archae survive in extreme environments.

3. Bacterial Form and Function

Explain the difference between a gram-negative or gram-positive bacterial cell.
Identify bacteria by their shape, size, and arrangement.

4. Protista Form and Function

Explain the differences in structures between the various types of protists.
Identify protists by their shape and structures.
Explain why protists are the most diverse of all eukaryotes.
Predict why the classification of protists is likely to change in the future as we learn more about how these organisms are related to each other and to members of other kingdoms.

5. Fungi Form and Function

Describe the structures of fungi.
Explain how fungi have diverse forms.
Explain the reproductive cycles of the fungi.

6. Viral Form and Function

Explain how viruses are not considered living organisms.
Describe the structures of all viruses and how some viruses can have different structures.
Describe how viruses reproduce in their host.
Explain how viroids and prions function.

7. Basic Microbiological Techniques

Describe and be able to perform proper aseptic technique.
Describe and be able to perform proper gram staining techniques
Be able to use the light microscope to identify different microbes.
Be able to make observations and identifications of microbes from images from SEM, TEM, and fluorescent microscopes.
Be able to grow microbes in cultures.